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INTRODUCTORY STUDY TO DEVELOP THE METHODOLOGY FOR SAFETY ASSESSMENTS OF OFFSHORE PRODUCTION FACILITIES

Prepared for the
Minerals Management Service
by
Belmar Engineering

August 1992

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BELMAR engineering & management services company

Suite 301 / 1650 South Pacific Coast Highway / Redondo Beach, California 90277-5613
Telephone 310-316-5934 / Telefax 310-316-5974

August 17, 1992

Mr. Charles E. Smith
Research Program Manager
Minerals Management Service
381 Elden Street, M/S. 647
Herndon, VA 22070-4817

Dear Mr. Smith,

Please find enclosed one copy of the report *"Introductory Study to Develop the Methodology for Safety Assessments of Offshore Production Facilities,"* which presents a summary of the results of the FAME study project. The report describes the work performed under the Minerals Management Service auspices as well as additional work performed by the undersigned.

The study program succeeded in the development of a fire and explosion accident database for Gulf of Mexico OCS platforms that is correlated to the population database. One of the interesting findings from a cursory analysis of the new database is that platforms with compressors have a more than seven times greater risk of a fire and explosion than platforms without compressors. This is a partial answer to one of the questions asked by the Marine Board in its 1990 study on inspection alternatives, i.e., "Are there platforms that have a greater susceptibility to accidents and should these platforms be selectively subjected to more thorough inspections or audits ?"

To the best of my knowledge the new fire and explosion accident database is the only one in existence that has the capability to analyze the causes and frequencies of off-shore accidents as they relate to type of platform, platform facility, or operation. A recommendation made by the Steering Committee to expand the fire and explosion database with other process related accidents, see Appendix 3 in the report, has not been done because of the early termination of the study program.

We have enjoyed working on this study project and would welcome an opportunity to work on similar study projects in the future.

Yours very truly,

R.C. Visser

R.C. Visser

Enclosure

cc: Ms. Sandra L. McLaughlin, Contracting Officer

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Summary

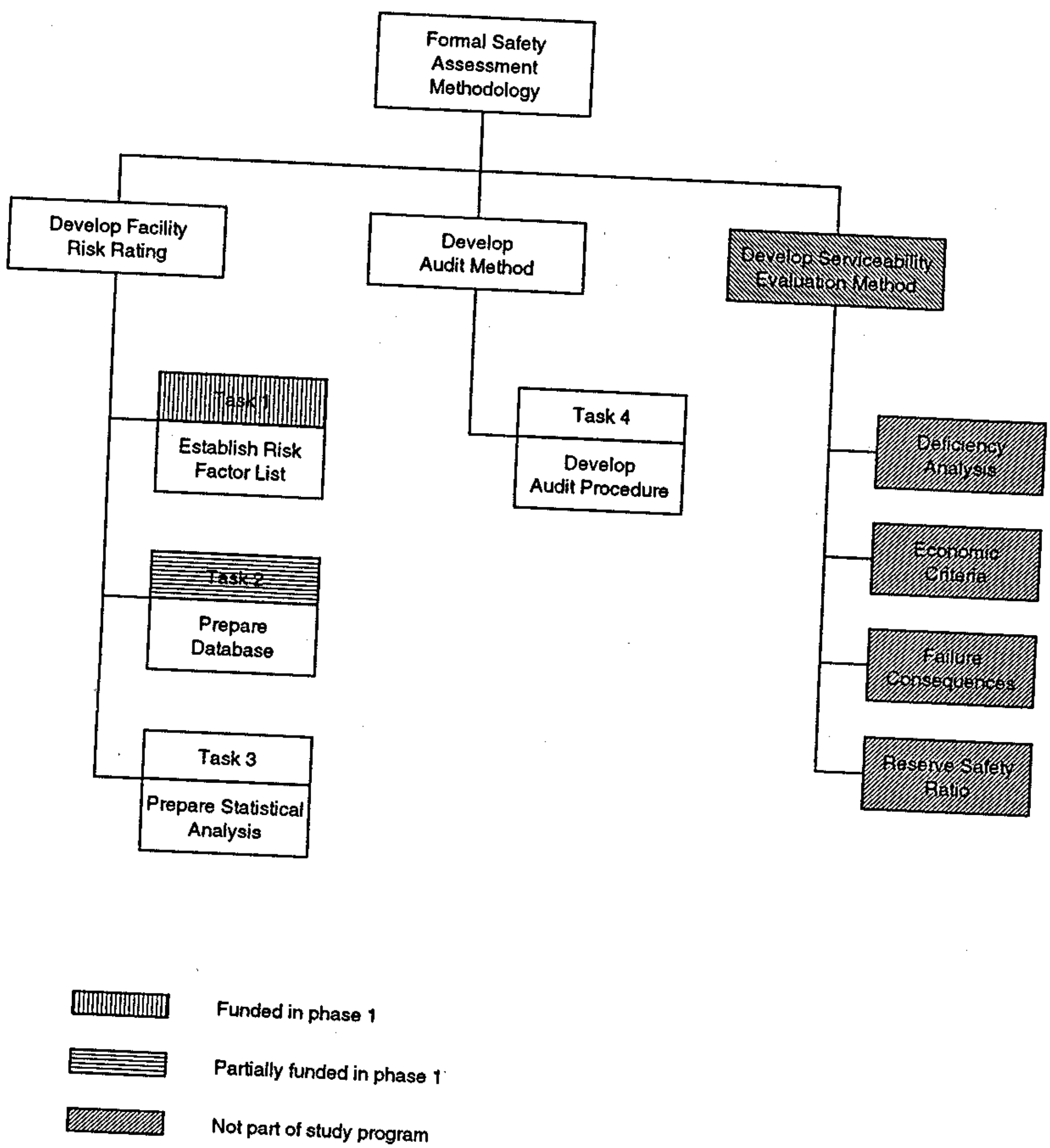
The FAME, an acronym for Facility Assessment, Maintenance and Enhancement, study project accomplished its initial objective of developing an accident database tied to a platform population database. The new database, currently restricted to fire and explosion incidents, permits the determination of incidence rates of specific risk factors which, in turn, will enable the future development of a platform facility safety screening method.

An accident database containing all 383 fire and explosion accidents that occurred in the nine year period between 1981 and 1990 on platforms in federal waters in the Gulf of Mexico was developed. This database was merged with two platform population databases containing information on all 4044 current and removed platforms in the Gulf of Mexico. The merged database permits detailed analysis of a number of the risk factors that are thought to contribute to fires and explosions.

Initial screening of the database indicates that there is no apparent relationship between the age of the platform structure and fire and explosion accidents. Whether or not such a correlation exists with the age of platform equipment cannot be determined with the currently available data.

There is, however, a strong correlation between the type of equipment on the platform and fire and explosion accidents. For instance, two-thirds of all fire and explosion accidents occur on platforms on which a gas compressor is located. The statistical risk of having a fire or explosion on a platform with a gas compressor is about 4 percent per year which compares to a fire and explosion risk of about 0.5 percent for all other platforms. Within the group of platforms with compressors there are a number of platforms that exhibit an even greater accident rate. The reason for this, which may be because of operatorship, type of equipment, location, or whatever, has not been further explored.

Figure 1. Work Breakdown Structure of the study project.



2. ACCOMPLISHMENTS

2.1 Task 1 - Evaluation Procedure

A first step in the program was to establish a standard procedure for identifying the causes of fires and explosions. A complete list of the factors that can contribute to the risk of a fire or explosion was developed and is shown in Figure 2.

2.2 Task 2 - Database Preparation

An accident database containing all 383 fire and explosion accidents that occurred in the nine year period from 1981 through 1989 during production operations on platforms in federal waters in the Gulf of Mexico was developed. This database is based on the Minerals Management Service events file, see Appendix 4, and was compiled from a number of different formats, see Table 1. This table also lists other databases that were obtained from the Minerals Management Service. The fire and explosion data for the year 1990 are available but have not as yet been incorporated into the database.

Only accidents that involved production operations are included in the database. Although information on accidents involving drilling operations are available, they have not as yet been included in the new database. The new database was generated in Excel format and subsequently converted into the Paradox database format.

The new fire and explosions database was merged with two platform population databases containing information on all 4044 current and removed platforms in the Gulf of Mexico. Information available in the Minerals Management Service Master - Platform and Structures databases includes details about platform equipment, quarters, operator, location, etc. These databases were in a text format, see Table 1, and were, through a rather convoluted method, see Figure 5-1 in Appendix 5, converted into the Paradox database format.

The merged database permits detailed analysis of a number of the risk factors on the basis of population data. To our knowledge this is the first Gulf of Mexico accident database that is now tied in to a population database. The new merged database can, if desired, be converted from Paradox into other formats such as dBase III, dBase IV or Excel.

Figure 2. Platform facility safety risk factors.

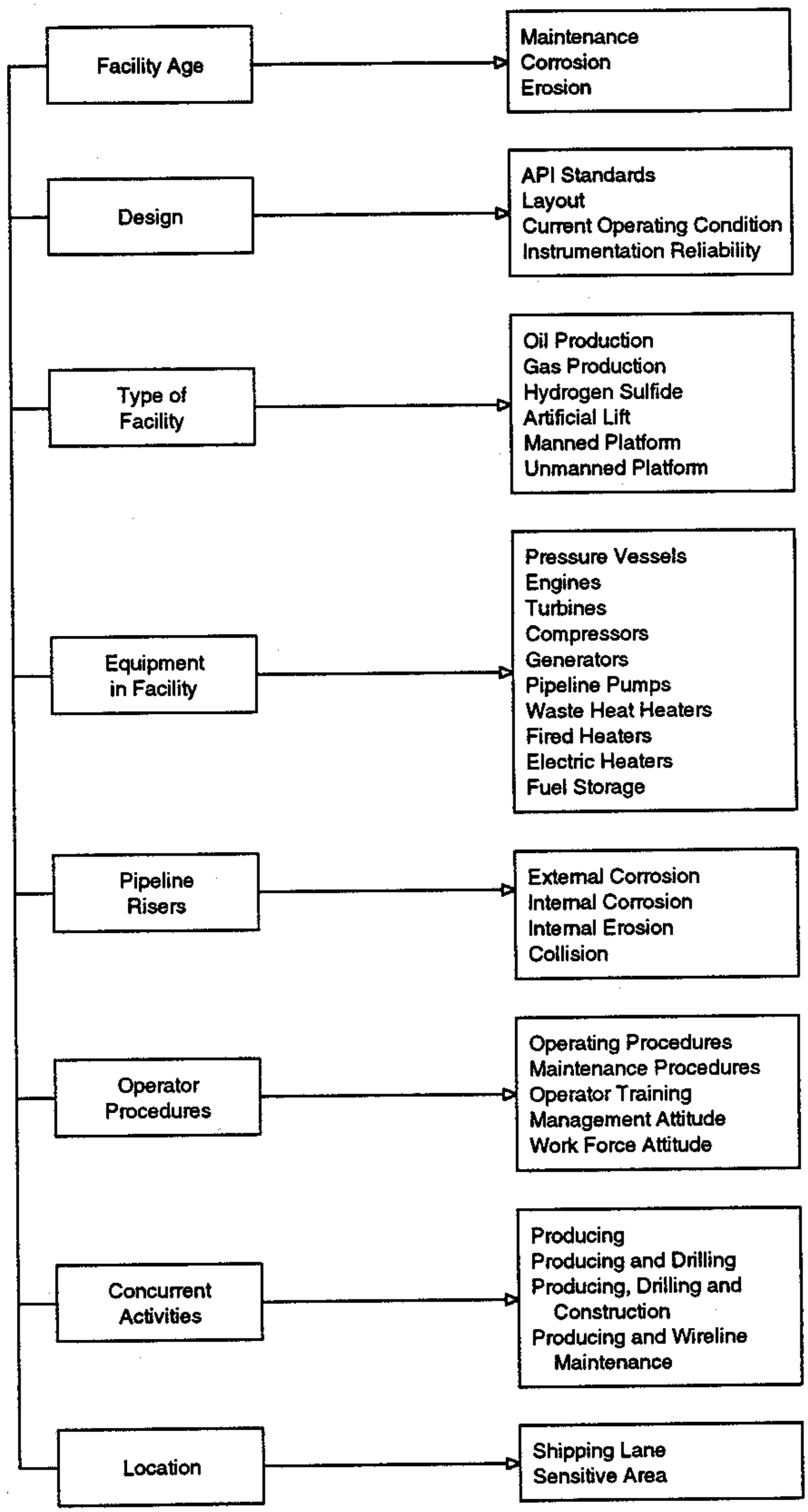


Table 1. Available Minerals Management Service databases and formats.

Period	Database Name	Area	Format
1981 1982-1987 1988-1989 1990	Events File Events File Events File Events File	GOM GOM GOM GOM	Printed Text Lotus 123 Printed Text dBase IV
1956-1986	Accidents	OCS	MS Word4 and Printed Text
to Mar 1992	Master-Platform (4000+ entries)	GOM	ASCII Text
to Mar 1992	Structures Platform (4000+ entries)	GOM	ASCII Text

2.3 Task 3 - Statistical Analysis

1. *General*

Although not funded by the study program, a number of statistical analyses were performed using the fire and explosion database and the later generated merged database. Results are shown in Figures 3 through 9 and are briefly described in the following.

2. *Incident Rate*

The annual fire and explosion incident rate for platforms in federal waters in the Gulf of Mexico for the ten year period from 1981 through 1990 is shown in Figure 3. This figure shows a significant drop in incident frequency over the period. This decrease in incident frequency may be attributable to greater attention to safety and personnel training, or, possibly, to reduced construction activity following the boom period of the early eighties.

Another factor may be the fact that the Minerals Management Service changed its reporting requirements in 1985. Table 2 lists the total reported incidents in the Minerals Management Service events file.

Table 2. Number of incidents in the MMS events file.

Year	Number
1981	175
1982	525
1983	527
1984	429
1985	501
1986	144
1987	79
1988	62
1989	53
1990	62
Total	**2557**

Figure 3. Annual fire and explosion incident rate on Gulf of Mexico OCS platforms.

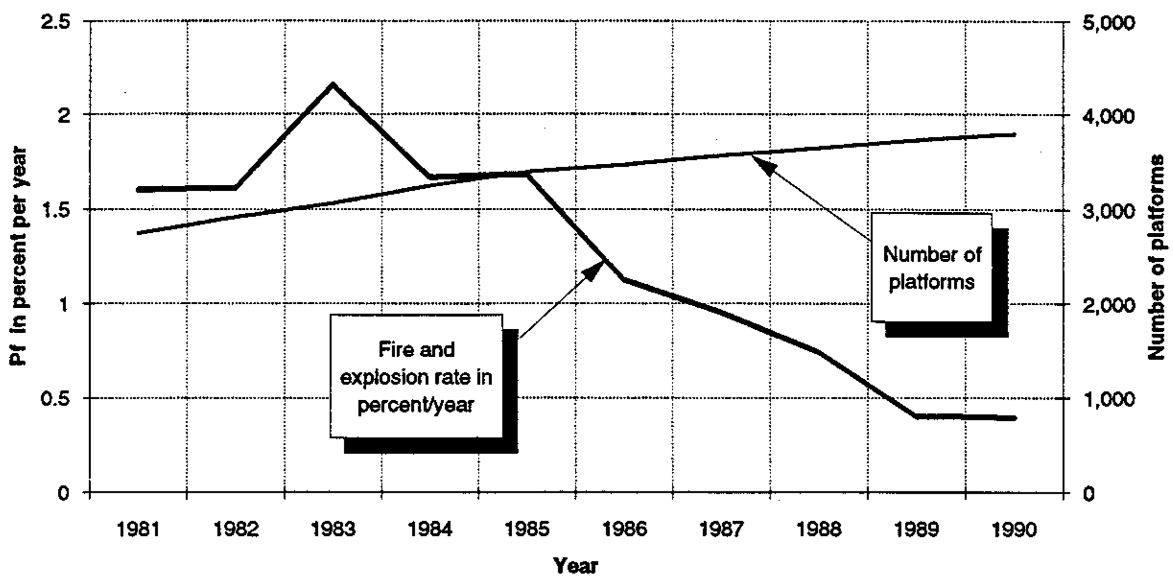
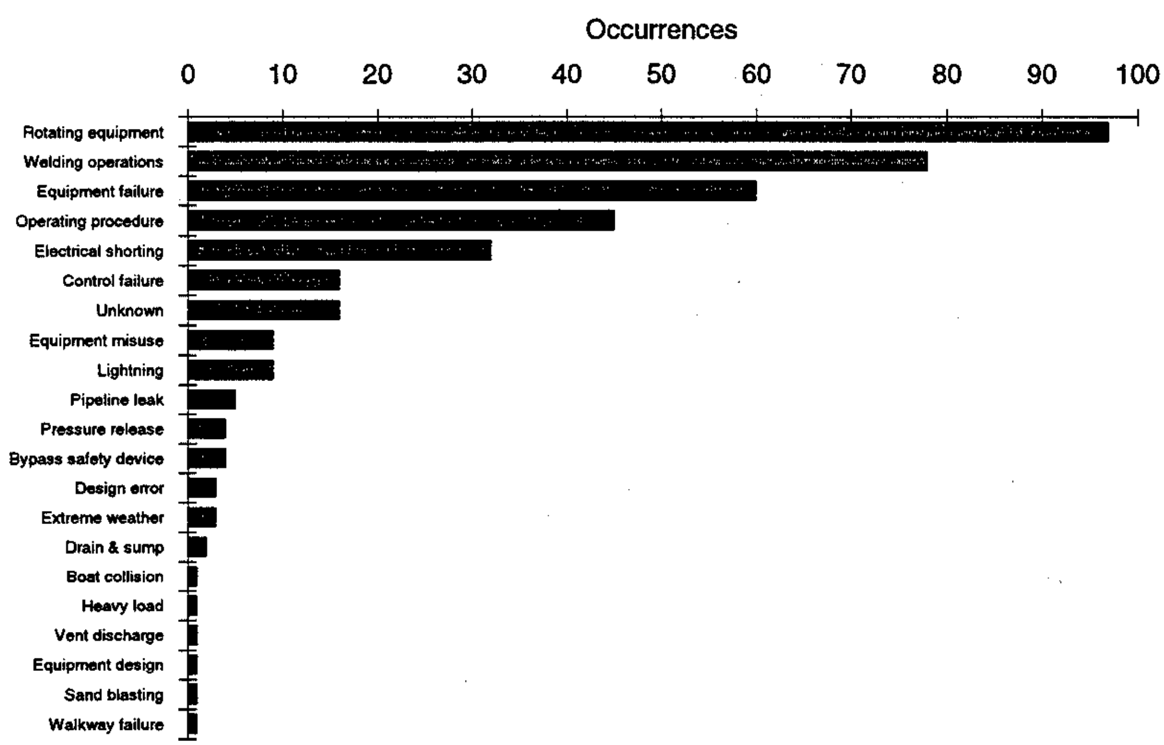


Figure 4. Distribution of fire and explosion causes.



As shown in Table 2 an order of magnitude reduction in recorded accident events occurred during 1986. Of the incidents listed in 1989 and 1990, only fifteen in each year were fires or explosions. During a personal communication with a representative of one major operator, however, it was mentioned that this particular company has in-house reports of at least a dozen platform fires or explosions every year. It is somewhat unlikely that this particular operator has the majority of all fires and explosions and, if there is a continuation of the study, the reason for this apparent discrepancy should be further investigated.

3. *Fire and Explosion Causes*

Figure 4 shows the distribution of causes of platform fires and explosions. As expected, the principal cause is from operation of rotating equipment, i.e. engines, compressors, or turbines. The next major category involves platform welding operations. Other major causes are equipment and control component failures, electrical shorting, and poor operating procedures.

4. *Age Factor*

At the start of the study it was surmised that aging of the equipment and piping on a platform facility may be a major contributing factor to fires and explosions. It makes sense that equipment failures will increase with age because of wear and tear and/or corrosion. On the other hand, pressures and hydrocarbon throughput volumes of the platform facility will decline as the field gets older, thus lessening the potential of, for instance, pressure leaks.

The evaluation shown in Figures 5, 6 and 7 to determine if age is indeed a contributing factor is ambiguous, because the database only contains the age of the platform structure and not the age of the facility or its equipment components. During the life of a platform many operators will refurbish or renew the facilities because all or part of the system may have become obsolete, or because conditions have changed. Also, changes in regulatory operating and environmental discharge requirements have necessitated premature equipment replacements. Accordingly, the age of the platform structure does not necessarily reflect the age of the platform facility equipment.

Figure 5. Cumulative percent distribution of platform fires and explosions by platform age at the time of the accident.

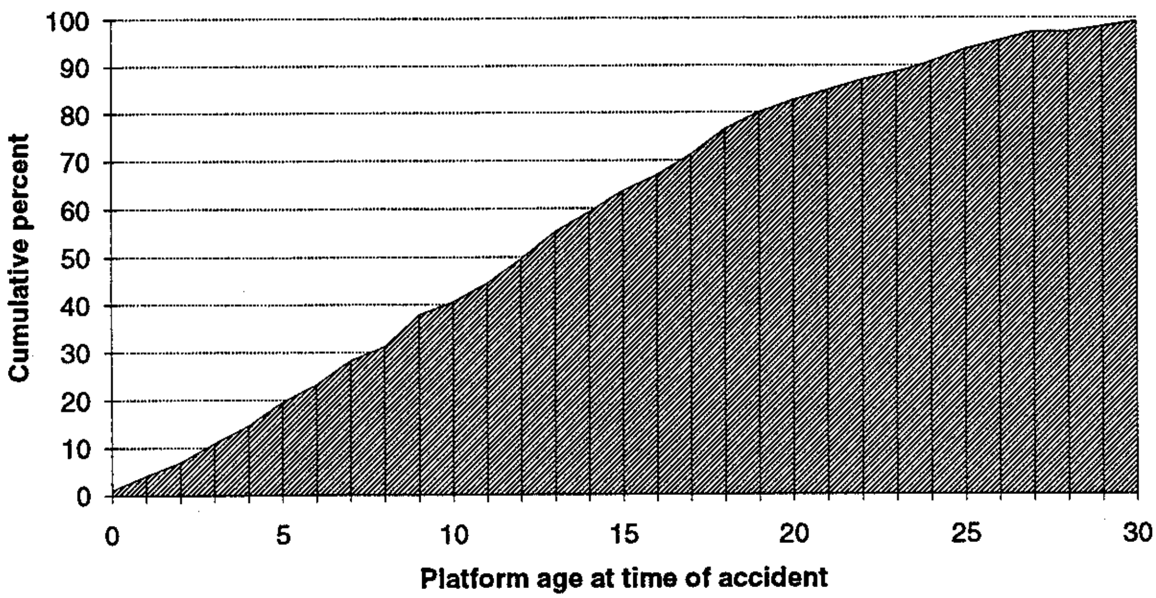
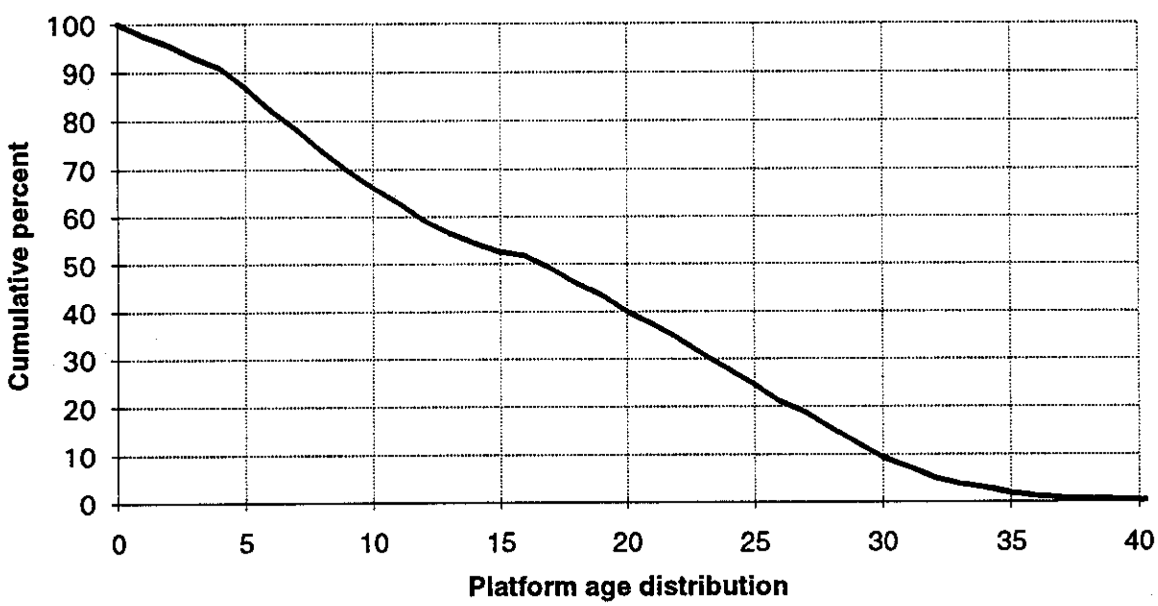


Figure 6. Age distribution of all Gulf of Mexico OCS platforms in 1989.



It is probably for these reasons that no correlation between the age of a platform structure and the frequency of fires and explosions can be demonstrated. Figure 5 represents the cumulative percent distribution of platform fires and explosions by platform age at the time of the accident. It is based on all fires and explosions in the 1981 through 1989 time period. Figure 6 represents the 1989 age distribution of the then total platform distribution in the Gulf of Mexico. When comparing the two figures there is no conclusive evidence that age is a factor. For instance, Figure 5 shows that 60 percent of all fires and explosions occurred on platforms ten years and older. Figure 6, however, shows that, in 1989, some 65 percent of all platforms were ten years or older.

A further analysis is shown in Figure 7. This figure shows, by year, the average age of all operating platforms and the average age of all platforms in that year that had a fire or an explosion. In most years the average age of platforms with accidents is actually less than the average platform age. The results are the same whether one uses median age or average age.

An additional check on the age factor was made by analyzing a group of platforms with the same equipment. Figure 8 shows the number of fires and explosions on platforms with compressors. Plotted on the same figure is the average age of the platforms at the time of the incident. The average age of the platforms with compressor accidents is not greater than the average age of all platforms in the incident year. Not checked, however, is whether the same holds true if the comparison is made against the average age of all platforms with compressors.

5. *Equipment Factor*

The combined database permitted an analysis to determine the effect of platform equipment type on accidents. Figure 9 shows the results for platforms with compressors, with storage tanks, with power generators, and with fired vessels. The results are somewhat surprising. The approximately 680 platforms with compressors were responsible for 250 of the 383 fires and explosions that occurred over the nine year study period. A platform with a compressor or a storage tank has, statistically, an annual probability of having a fire or explosion of four percent.

Figure 7. Average age of all operating platforms and average age of platforms with a fire or explosion by year of occurrence.

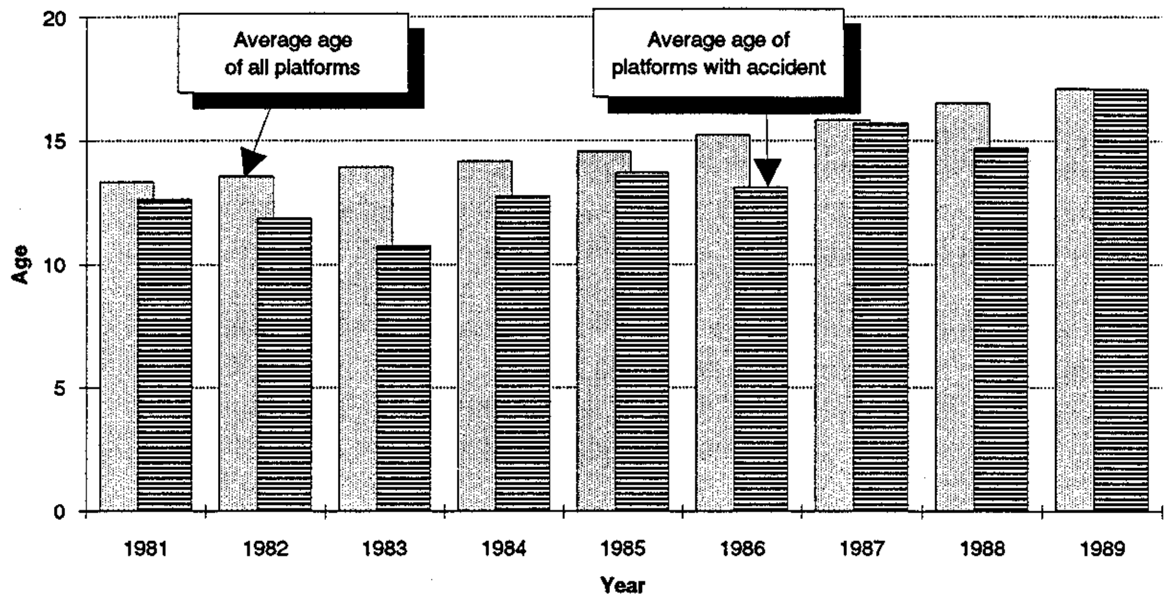
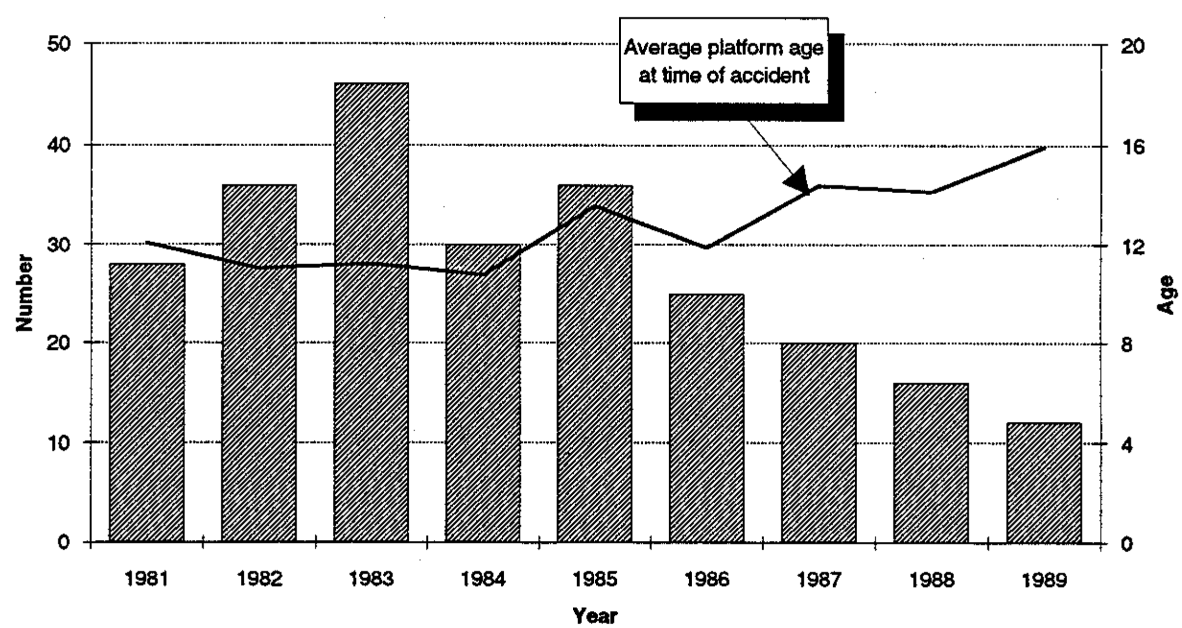


Figure 8. Number of fires and explosions on platforms with compressors.



This compares with a statistical annual probability of a fire or explosion on all other platforms of 0.5 percent averaged over the nine year of available data. Compared with platforms with compressors, the platforms with fired equipment have, unexpectedly, a much lower risk of a fire or explosion.

A more detailed analysis of the incidents on the platforms with compressors established that several of these platforms had multiple incidents with one platform having seven reported incidents over the nine year period. Table 3 summarizes the results.

No attempt has as yet been made to determine why certain platforms with compressors have a greater accident rate. Plausible causes that could be investigated are operatorship, type of compressor, i.e., turbine or reciprocal, facility size, equipment arrangement, and probably a number of other factors.

Figure 9. Average annual fire and explosion incident rate on platforms with listed equipment.

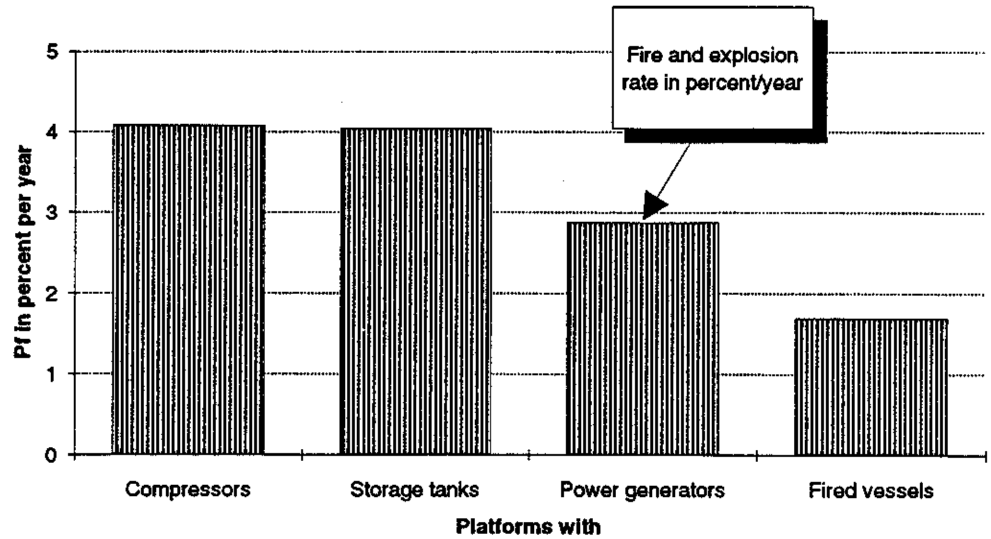


Table 3. Distribution of fire and explosion incidents on platforms with compressors.

Incidents per platform	Number of platforms
1	97
2	42
3	13
4	3
5	2
6	0
7	1

3. CONCLUSIONS

The study program has not progressed far enough to make definitive conclusions regarding the cause of platform facility accidents and how this information can be used for a screening process. Based on the work to-date the following preliminary conclusions can be drawn.

1. The risk of a fire or an explosion on an offshore platform is influenced by the type of equipment that is located on the platform.

2. Platforms that have a compressor have a more than seven times greater possibility of experiencing a fire or an explosion than platforms without compressors.

3. There is no apparent correlation between the age of the platform structure and the possibility of having a fire or an explosion. Data is not currently available to determine if equipment age is a factor.

4. REFERENCES

1. Bea, R.G. et al.: *"Development of AIM (Assessment, Inspection, Maintenance) Programs for Fixed and Mobile Platforms,"* OTC 5703, (1988).

2. Marine Board: *"Alternatives for Inspecting Outer Continental Shelf Operations,"* National Academy Press, Washington, DC (1990).

3. Minerals Management Service: *"Accidents Associated With Oil & Gas Operations, OCS 1956-1986,"* OCS Report MMS 88-0011, March 1988.

APPENDIX 1

1. INTRODUCTION

1.1 The Problem

There are currently over 3700 oil and gas production platforms in operation in the federal waters of the United States. Of these, approximately 1600 platforms, or almost 45 percent, see Figure 1.1, are over twenty years old.[1*]

Concerns regarding fatigue, corrosion and underwater damage, together with the need for structural re-qualification of these aging platforms have been addressed in a major study initiated by the Mineral Management Service in 1984.[2] The project was subsequently joined by industry and other governmental organizations. This study, which completed its fourth phase in 1989, has produced general guidelines and procedures that are now used by industry and government to re-qualify platforms in the Gulf of Mexico.[3]

No comparable study has been performed on the topside facilities of offshore platforms. Yet it is now recognized that the principal hazard to an offshore operation is not from structural collapse but rather from the operation of the production facilities. A brief review of the Mineral Management Service accident database shows that over the period from 1956 through 1986 a total of 779 incidents involving an explosion and/or fire occurred on platforms in federal waters around the United States.[4] These incidents resulted in the loss of three platforms. The annual probability of experiencing an explosion or fire is shown on Figure 1.2. By comparison, the annual probability of experiencing a platform structural failure is an order of magnitude lower.[5]

There is no clear evidence from the data shown in Figure 1.2 of any improvement from earlier years. Part of the reason is that until the early 1970's minor accidents were not reported. Even so, when investigating the most recent decade, there is no apparent improvement, despite substantial regulatory and industry efforts to improve safety and personnel training.

It is possible that one reason for the lack of improvement is the fact that production facilities are getting older. It is also possible that the change in fire and explosion rates can be a reflection of the degree of construction activity as indicated by the drop-off in the latter part of the 1980's. Other factors may be involved.

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* References are found on page 1-21

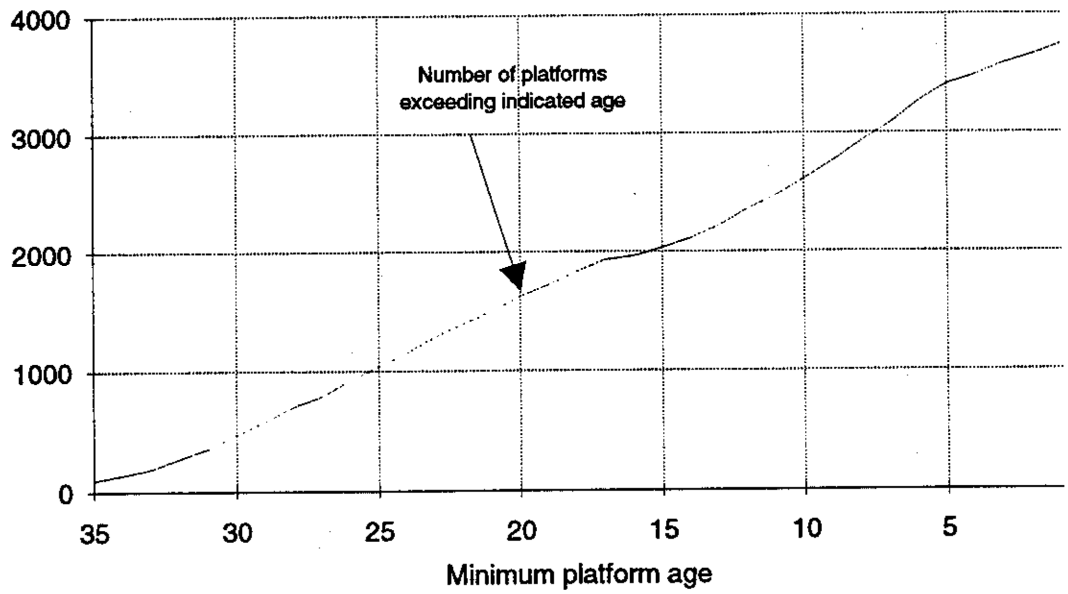


Figure 1.1 Age of platforms in federal waters of the United States as of January 1991.

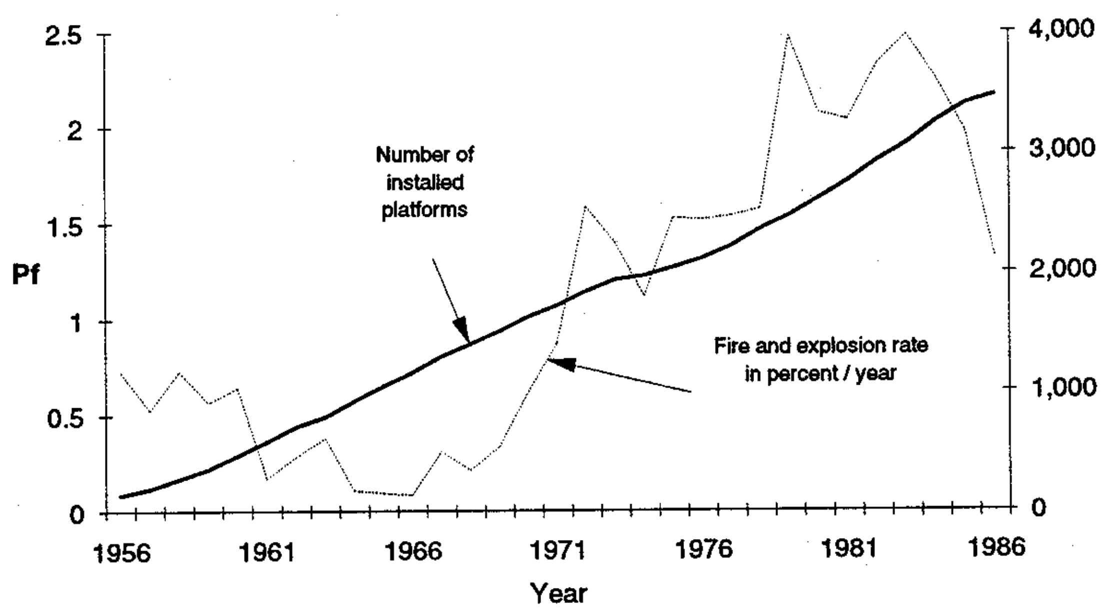


Figure 1.2. Average annual fire and/or explosion incident rate on offshore platforms in Unites States federal waters.

A brief review of the data indicates that many fires and explosions are due to improper operating, construction and maintenance procedures and are not design related.[6] Others, however, are due to failure of equipment, piping, electrical systems, etc. An in-depth analysis of these accidents may provide guidance for targeting spot inspections by the Mineral Management Service, provide target intervals for process hazard analysis reviews, facility operation audits and updates based on risk levels and aid in modifying American Petroleum Institute recommended practices.

As mentioned above, some forty five percent of the platforms in the OCS are 20 years or older. Although the platform facilities are not necessarily of the same vintage as the platform structure, it is reasonable to assume that a majority of the equipment on many platforms is of the same age as the platform structure. Over the years the production equipment, mechanical equipment and safety devices has been exposed to corrosion, erosion, and wear and tear. The degree to which this may contribute to fires and explosions has not been adequately evaluated.

The situation will get worse as time marches on because most offshore oil and gas fields have an economic life well beyond 25 years. It is quite probable, therefore, that, over time, the incidence of fires and explosions on the older platforms will increase.

Platform operators and owners are faced, therefore, with the need to extend the operating life of many of the older facilities. With uncertain crude oil and natural gas prices, and increasing maintenance costs, owners, operators, and regulators must find a reasonable way to utilize and re-qualify existing facilities.

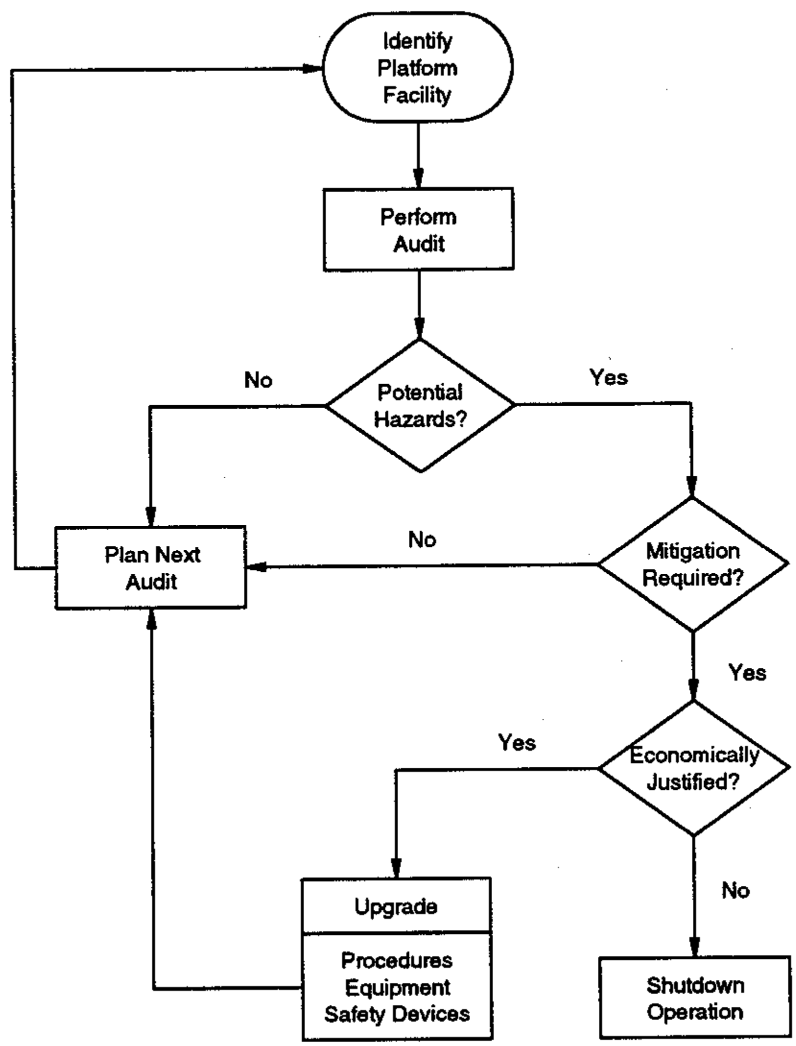
1.2 Re-qualification Procedure

A methodology for a re-qualification procedure for existing platforms is outlined in Figure 1.3. The steps that would be involved in such an effort are:

1. Select a candidate facility using a *screening* procedure,

2. Perform an *audit*, or safety analysis, of the facility,

Figure 1.3. Platform facility re-qualification approach.



3. Assess the serviceability or *fitness for purpose* of the facility,

4. Implement a *remedial* or upgrade program.

This procedure is analogous to the methodology developed in the AIM program for structural re-qualification. If it can be made to work in a similar fashion for offshore topsides, the end result would be the characterization of the serviceability of a platform facility through what might be called a Reserve Safety Ratio. This ratio would be similar to the structural Reserve Strength Ratio developed in the AIM program.

There are some doubts, however, whether the methodology that applies to structural re-qualification of a platform can also be used to re-qualify production facilities. The analysis of the safety of a production operation will be far more subjective than the analytical approach that can be used for determining the residual structural safety of a platform.

It is, therefore, proposed in this study to, at least at this time, address only the first two steps in the re-qualification program. If feasible, the program can be expanded at a later date to investigate steps three and four.

1.3 Study Objective

The objective of this study program is limited, therefore, to (1) evaluating existing data to develop a procedure for rating facilities for overall risk, and, (2) establishing the methodology to perform an audit of a facility and its operation. These would be the first two steps in the ultimate goal of developing a practical and non-prescriptive engineering approach for the re-qualification of existing offshore topside oil and gas production facilities.

It is planned to perform the study in consultation with an industry advisory panel to ensure that the best available industry engineering and operational knowledge is integrated into the effort.

It is anticipated that, following the successful completion of this study program, the methodology will be presented to industry and other governmental organizations in a workshop and that the methodology will subsequently be tested and verified on one or more candidate production facilities.

It is further anticipated that the program will ultimately lead to either a new API recommended practice, or in revisions to the existing recommended practices. Thus, this work should also aid in the process hazard analysis document currently being prepared by the API 2G Committee and the efforts of the American Petroleum Institute and the Mineral Management Service to develop management programs that will promote safety and environmental protection.[7]

The organization of, and participation in, a workshop and any follow-up testing and verification programs are not part of this proposal.

2. TECHNICAL APPROACH

2.1 General

The proposed study effort will consist of four basic tasks. Three of these tasks are related to the first step listed above, i.e. the screening process, and the fourth task to the audit methodology. A work breakdown structure for the proposed program is shown in Figure 1.4.

The first task will consist of developing the factors to be evaluated and establishing a methodology for gathering data. A preliminary listing of these factors is shown in Figure 1.5. The result from this task will be a revised *listing of factors* and a detailed plan for obtaining the data.

The second task will be the actual gathering of data on fires and explosions and listing causes, age, platform type, equipment type, ongoing activity, etc. It will also require determination of the population of platforms with each equipment type so that incidence rates can be calculated. The result from this effort will be a complete *accident database.*

The third task will involve a statistical analysis of the data from task two to determine which of the parameters is determinant. The result would be a method to assign a *facility risk rating* to a particular facility and operation.

The fourth task will consist of establishing the methodology to perform a requalification audit of a facility and its operation. The result will be an *audit method* that inventories the condition of the facility and analyzes the adequacy of the facility and its operation on the basis of accepted industry standards and regulatory requirements.

All four tasks will include a thorough literature search of relevant publications.

As part of the study program it is planned to meet with representatives from industry and governmental agencies, the advisory panel, to obtain their input for the methodology. Travel funds for these meetings are included in the cost estimate.

Each of the tasks is described in more detail in the following sections.

Figure 1.4. Work Breakdown Structure of the study project.

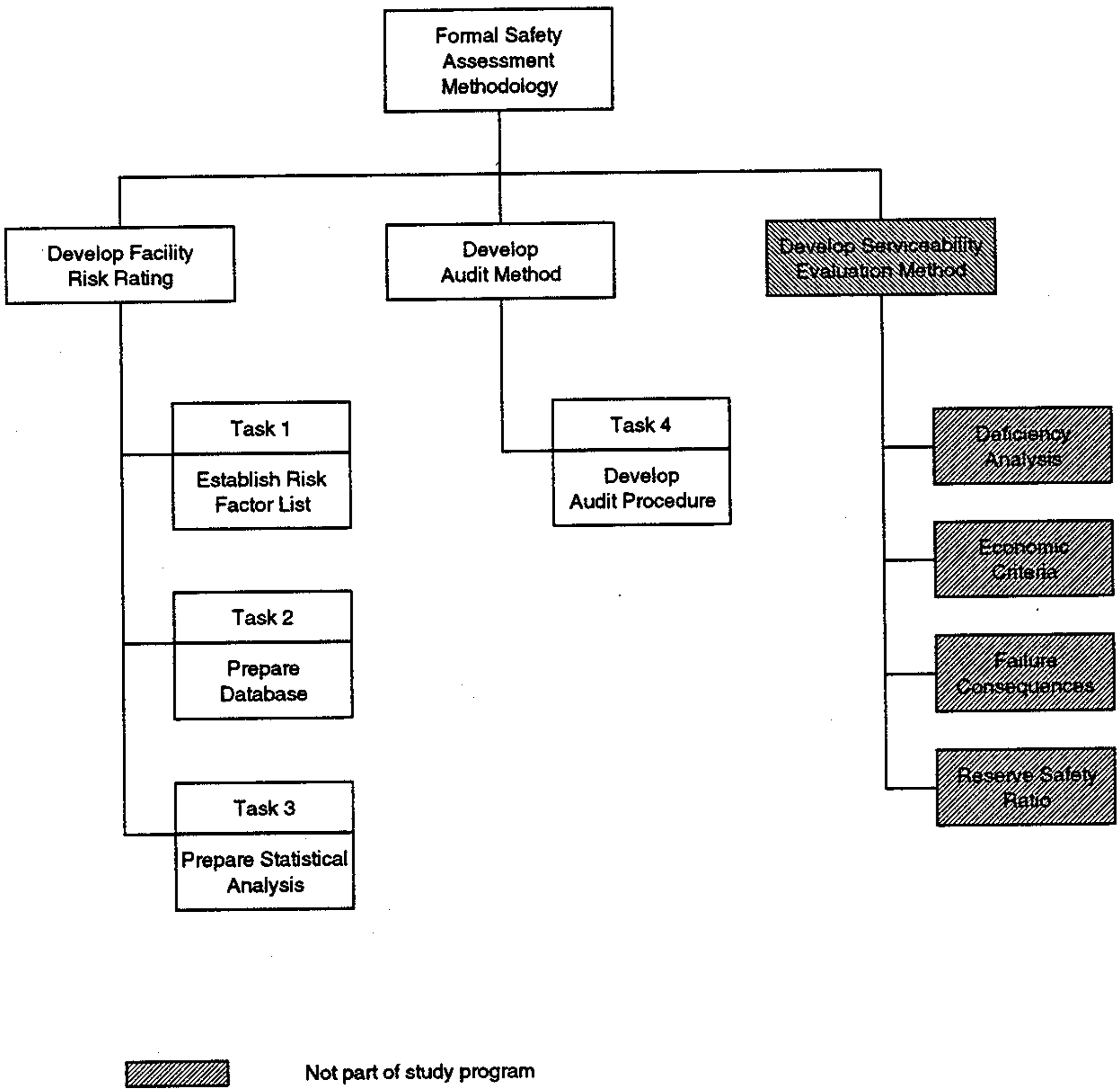
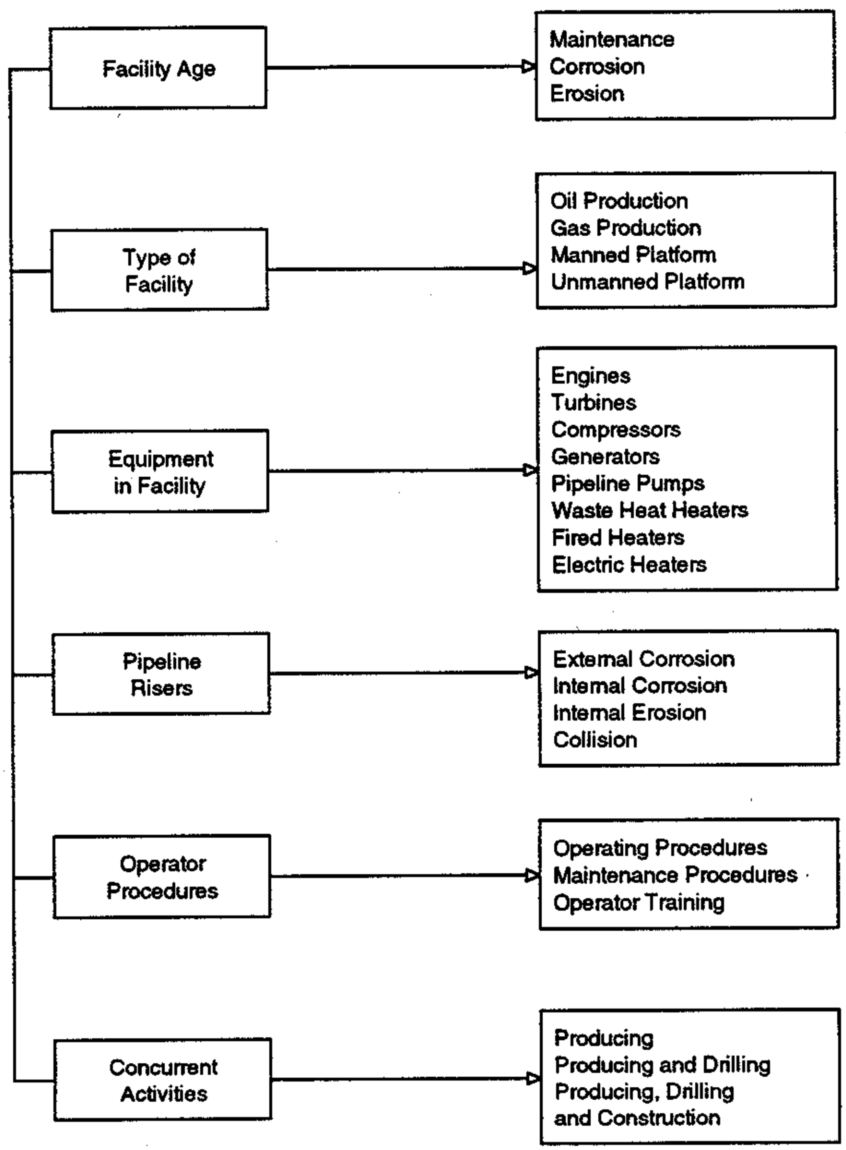


Figure 1.5. Factors to be considered in evaluating facilities risk.



2.2 Task 1 - Evaluation Procedure

A database from the Mineral Management Service events file is currently available in-house at Paragon Engineering.** This database lists all fires and explosions in the Gulf of Mexico, by cause, for the period from 1982 through 1989. This data will be reviewed to determine the format of all data to be collected.

Particular attention will be given to assure that a standard procedure is selected which will identify those fires and explosions caused by, or exasperated by, failure of equipment, piping, shutdown systems and other aspects of design, as well as those caused by improper operating and maintenance procedures and inadequate training. The procedure will have to assure that cause is attributed to the correct equipment type.

Reference material that will be researched to develop the proper procedure will include existing offshore databases that are available in-house at Belmar Engineering.[8,9,10]

An important part of this task will be the formulation of a detailed plan how and where to obtain the basic data.

2.3 Task 2 - Gathering Data

The existing in-house database will be expanded with data available from the Mineral Management Service to include 1981 and 1990 data, thus providing a full ten years of history. The new data, as well as the existing data, will be analyzed and classified according to the format established in Task 1.

An important part of this task will be to develop population statistics from which incidence rates can be determined. It is planned to do this by choosing a representative year for which platform information, such as, for instance, safe charts, is available in the Mineral Management Service files and determining the number of platforms with each equipment type.

** Mr. K.E. Arnold, a participant in the study, is Senior Project Manager of Paragon Engineering.

This task will involve an extended research effort at the Mineral Management Service field offices in New Orleans and Camarillo to retrieve the required information.

The data from this effort will be accumulated and categorized in a computerized database. The database program to be used will be a commercially available software program.

2.4 Task 3 - Statistical Analysis

Once data has been entered in the data bank it will be possible to use statistical analysis techniques to determine which factors are most likely to affect the probability of fire or explosion occurring in any one year. By regression analysis it should be possible to develop an equation which can be used to evaluate the relative risk potential for any platform. It should also be possible to normalize the data for equipment type and determine the degree to which age, layout, operator/owner, or staffing contribute to risk.

A further factor that enters into the determination of the facility risk factor equation is the consequence potential. The consequence potential will include such parameters as the potential for damage to property, lives, resources and the environment.

The goal of this task is that the developed methodology will enable the assignment of a *facility risk rating* for a specific platform facility.

2.5 Task 4 - Develop Audit Method

Over the past ten years or so there has been a gradual acceptance of the use of formal analytical techniques and risk management audits to perform hazard and loss prevention analyses in the offshore industry. There are a large number of methods available to perform these analyses although many are specific to a only a particular application.[11,12,13]

The database and statistical analysis derived in Tasks 2 and 3 should point out which equipment types, procedures and/or operations contribute most to risk.

This task will involve the analysis of several methods for the safety review and selecting the method, or combination of methods, that is most appropriate for the purpose of a re-qualification program with particular attention to those items that create the greatest risk.

The methodology should include the preparation of an inventory (database) of all pertinent information related to the design and operation of a facility. The audit should address and assess the adequacy of the various components of a facility on the basis of industry standards and regulatory requirements.

7. REFERENCES

1. Mineral Management Service: *"Federal Offshore Statistics: 1989,"* OCS Report 90-0072, (1990).

2. Bea, R.G. et al.: *"Development of AIM (Assessment, Inspection, Maintenance) Programs for Fixed and Mobile Platforms,"* OTC 5703, (1988).

3. University of California: *"Preservation of Ageing Marine Structure,"* Symposium at UC Berkeley, August 1990.

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13. Belmar Engineering: *"Platform Risk Management Audit Program,"* Study prepared for the California State Lands Commission, (1988).

APPENDIX 2

PROJECT TEAM

Robert C. Visser	Belmar Engineering
Hollis B. Carlile	
Kevin O'Malley	
Kenneth E. Arnold	Paragon Engineering

STEERING COMMITTEE ORGANIZATIONS

Minerals Management Service - New Orleans

Chevron USA
Amoco Production Company
Conoco Inc.
Exxon Company USA
Mobil Research & Development Corporation
Shell Oil Company
Texaco USA

Waldemar S. Nelson

FAME PROJECT STEERING COMMITTEE

Mr. Kenneth E. Arnold
Paragon Engineering Svcs.
13939 Northwest Freeway
Houston, TX 77040

Telephone: 713-462-8828

Mr. Robert Folse
Chevron USA
1515 Poydras St.
New Orleans, LA 70161

Telephone: 504-589-3427

Mr. Bob Hicks
Exxon Company USA
P.O. Box 60626
New Orleans, LA 70160-0626

Telephone: 504-561-3432

Mr. M. Andy Jones, Jr.
Shell Oil Company
P.O. Box 2099
Houston, TX 77252

Telephone: 713-241-5462

Mr. James A. Melancon
Waldemar S. Nelson
1200 St Charles Avenue
New Orleans, LA 70130-4334

Telephone: 504-593-5397

Mr. Lee Pantermuehl
Amoco Production Company
P.O. Box 3092
Houston, TX 77253-3092

Telephone: 713-556-4362

Mr. Gary Sargent
Mobil Research & Development Corporation
13777 Midway Road
Dallas, TX 75244-4390

Telephone: 214-851-8345

Mr. Charles E. Smith
Mineral Management Service
381 Elden Street M/S 647
Herndon, VA 22070-4817

Telephone: 703-787-1559

Mr. Paul H. Spangler
Conoco Inc.
P.O. Box 2197
Houston, TX 77252

Telephone: 713-293-2591

Mr. Maurice Stewart
Mineral Management Service
1201 Elwood Park Blvd.
New Orleans, LA 70123

Telephone: 504-736-2843

Mr. Allen J. Verret
Texaco USA
P.O. Box 61050
New Orleans, LA 70161-1050

Telephone: 504-595-1220

Mr. Robert C. Visser
Belmar Engineering
1650 S. Pacific Coast Highway / Suite 301
Redondo Beach, CA 90277-5613

Telephone: 310-316-5934

APPENDIX 3

HIGHLIGHTS FROM THE
FIRST FAME STEERING COMMITTEE MEETING

New Orleans, February 5, 1992

Chevron Conference Room

1. Mr. Charles Smith from Minerals Management Service headquarters introduced the FAME project and its objectives. The purpose of this project is to develop a facility screening method to enable operators to assess the integrity of those facilities that have the greatest risk. The availability of a screening method will enable operators to selectively apply risk and reliability methods. The program is very similar to the AIM structures project which was initiated by the Minerals Management Service in 1986. The purpose of that project was to provide operators with a practical approach for a qualitative assessment of an existing offshore platform structure.

2 Mr. Visser (Belmar) reviewed the background of the AIM structures project. The methodology that was developed enables an investigator to determine the, so-called, reserve strength ratio (RSR) of an offshore platform structure which, in turn, determines the suitability for service of the structure. A decision tree can then be developed to determine what, if anything, needs to be done to the structure.

3. Most of the members of the steering committee, being facility rather than structure oriented, were not familiar with the details and workings of the AIM project. AIM I was funded by the Minerals Management Service and reviewed by an industry advisory committee. The subsequent AIM II and III projects were funded by the MMS, California State Lands Commission, U.S. Coast Guard and 20 companies. Results from the project are now being used by industry. Two papers, see references 1 and 2, describing and illustrating the method were presented at the Offshore Technology Conference in 1988 and 1989.

4. The FAME project intends to develop a similar procedure for platform facilities. The steps needed to accomplish this goal were described and discussed. The first three tasks involve the determination of a risk factor list, the development of a database and a statistical analysis to de-

termine common parameters for accidents, i.e., age, type of operation, type of equipment, etc.

5. It was pointed out by Mr. Arnold (Paragon), and others, that the Marine Board has recently advocated the use of an offshore facility annual inspection program at selected sites based on a safety susceptibility ranking (Reference 3, pages 48 and 70). To enable the use of this method the Marine Board recommended that the Minerals Management Service perform analyses of the existing accident data bases (pages 63 and 67) and accumulate additional data (page 70).

6. Initial results from a preliminary analysis of ten years of data from the events file were presented and discussed. This review indicates that the majority of fires and explosions are caused by rotating equipment related failures. The fire and explosion accident data from one year has been correlated to the year the particular platform was installed. This data needs further refinement to determine if fire and explosion, and, more specifically, equipment related accidents are age related or not.

7. It was the general consensus of the participants that the survey of the events data file should not be restricted to fires and explosions, but should include all accidents.

8. It was also agreed by most participants that injuries that are unrelated to process accidents should be excluded.

9. The table of platform risk factors was reviewed and several additions were suggested by the participants. These included adding "Quarters" and "Wellheads" under the Equipment heading, adding "Remaining Field Life" under the Facility Age heading, adding "Location of Risers", "Current Operating Conditions Versus Design Conditions" to the Pipeline heading, adding "Wireline" and "Maintenance" to Concurrent Activities", and adding "Management Attitude" and "Work Force Attitude" to the Operator Procedures heading.

10. There was a general discussion regarding incident versus accident reports. Shell UK has initiated a formal procedure for reporting all offshore incidents that have the potential of becoming an accident. A copy of the methodology was passed around. Mr. Jones (Shell) men-

tioned that Shell Oil Company has just started a similar program. Mr. Spangler (Conoco) advised that his company has a similar system in operation and has accumulated a data file of some 600 incidents per year over a two year period. The consensus of the group was that availability of this data would be very beneficial to the project.

11. There was a brief discussion what is being done in other industries. The Nuclear Regulatory Commission has had an ongoing nuclear plant aging research program. One of their publications, which was passed around, presents in some detail aging related problems with mechanical equipment. The ASME has recently published a manual to determine the remaining strength of corroded pipelines. The AIChE publishes the, so-called, "Dow's Fire and Explosion Index Hazard Classification Guide", which provides a procedure for preparing a risk analysis of a process unit. Time was not available to canvas the participants regarding their knowledge of other related studies or research projects.

12. Two other items were discussed where assistance from industry would be helpful. These items included, (1) providing information when facilities were replaced or upgraded and (2) company accident reports. This information would be requested by individual contacts with steering committee members when the study is further along and the need for the information becomes apparent.

13. The next meeting of the steering committee will be in October in the Washington, DC area in conjunction with the SPE annual meeting.

References

1. Bea, R.G. Puskar, F.J., Smith, C. and Spencer, J.: *"Development of AIM (Assessment, Inspection, Maintenance) Programs for Fixed and Mobile Platforms,"* OTC 5703 (1988).

2. Martindale, S.G., Krieger, W.F., Paulson, S.K., Hong, S.T., Petrauskas, C. and Hsu, T.M.: *"Strength/Risk Assessment and Repair Optimization for Aging, Low-Consequence, Offshore Fixed Platforms,"* OTC 5931 (1989).

3. Marine Board: *"Alternatives for Inspecting Outer Continental Shelf Operations,"* National Academy Press, Washington, DC (1990).

FIRST STEERING COMMITTEE MEETING

FAME PROJECT

February 5, 1992

Chevron Conference Room, New Orleans, Louisiana

AGENDA

9:00	Welcome and Introductions
9:15	Project Objectives - Charles Smith
9:30	Project Background - Bob Visser
	AIM Structures Project
	Topside Concerns
10:00	FAME (Facilities Assessment, Maintenance & Enhancement) Project
	Description
	Overall Project Goals
	Current Scope
10:30	Break and Discussions
11:00	Facility Risk Factors
12:00	Lunch
1:00	Data Gathering
	MMS Data
	Industry Data
	WOAD
	IFP
	Others
2:15	Interaction with API Committees - Ken Arnold
2:45	Future Meetings and Closing Remarks - Bob Visser
3:00	Adjourn

APPENDIX 4

AVAILABLE DATABASES

1. GENERAL

The accident and equipment reliability databases that are available and have potential application in the study program are listed on Tables 4.1 and 4.2.

The increasing use of probabilistic risk analysis methods to evaluate the reliability of offshore operations has brought with it a demand for reliable information of historical events.[1] As a result there are now a number of offshore related databases of varying sizes in existence. These include databases run by governments, industry associations, universities, consultants and oil companies. The quality of these databases varies greatly.

There are three types of databases that are of potential value to the study project. These are (1) accident or event databases, (2) accident or event frequency databases, and, (3) equipment reliability databases.

2. AVAILABLE ACCIDENT DATABASES

2.1 Minerals Management Service

The most useful database for the study program is the offshore events file being maintained by the Mineral Management Service. The database was initiated in 1971 to keep track of blowouts, fires, explosions, oil spills and fatalities in the federal waters of the Gulf of Mexico. At the present time it contains more than 4700 events which go back to 1965. This data comes from a population of over 3700 platforms. Prior to 1971 only major blowouts and fires were entered. In 1971 the regulations were revised requiring all operators to report all fires, explosions, oil spills greater than one barrel, and fatalities to the Mineral Management Service. In 1986 reporting requirements were changed and, as noted in the main part of the interim report, there has been a significant drop in reported incidents.

The data is currently stored in different formats. Earlier data is stored in the GYPSY database program. This is a non-standard program and precludes the data from being readily accessible and manipulated. Recent data is compiled in dBase IV format. During an earlier study by Paragon Engineering part of the events file data was converted into Lotus 123 format.[2]

Table 4.1. Data bases available from the Minerals Management Service.

Minerals Management Service			
Period	**Name**	**Area**	**Format**
1981 1982-1987 1988-1989 1990	Events File Events File Events File Events File	GOM GOM GOM GOM	Printed Text Lotus 123 Printed Text dBase IV
1956-1986	Accidents	OCS	MS Word4 and Printed Text
to Mar 1992	Master-Platform (4000+ entries)	GOM	ASCII Text
to Mar 1992	Structures Platform (4000+ entries)	GOM	ASCII Text

Table 4.2. Data bases available from other organizations.

VERITEC			
Period	**Name**	**Area**	**Format**
1970-1988	WOAD Databank	World	dBase III

INSTITUT FRANÇAISE DU PÉTROLE			
Period	**Name**	**Area**	**Format**
1955-1989	IFP Platform Databank	World	ASCII text

RM CONSULTANTS			
Period	**Name**	**Area**	**Format**
Current to 1989	HARIS V5.0 Data System, Equipment Reliability Data		MS Q-BASIC

OREDA			
Period	**Name**	**Area**	**Format**
1980-1984	Oreda-84, Offshore Reliability Data	North Sea	Printed Text

The Mineral Management Service offshore events file is not tied in to the population data, and it is, therefore, not possible to extract accident frequency information from the database.

The Minerals Management Service does have available a database that lists all platforms in the Gulf of Mexico and provides information on each platform regarding location, operator, manning, type of equipment, etc. The information is located on two separate databases, the Master-Platform and the Structures database.

Also obtained from the Minerals Management Service was a disk with the text of the 1988 summary report covering offshore accidents from 1956 to 1986.[3] This database disk, with the text in MS Word4 format, proved useful in finding information on specific accidents.

2.2 Institute Française du Pétrole

Another available database, see Table 4.2, is the worldwide accident database compiled by the Institute Française du Pétrole. Unfortunately, the accident identification and categorization methodology used in this database is not realistic and, for the purpose of this study, the information is essentially useless. The database does provide excellent reference material for specific accidents. Like the MMS events file this database is not tied in to population data.

2.3 Other Databases

There are also a number of specialized accident databases being maintained by individual oil companies, insurance companies, etc. Several oil companies have recently initiated the recording of near-miss accidents. The availability of such a database would be extremely helpful to the study.

The U.K. based E&P Forum has recently initiated a program to gather hydrocarbon release data. This program, which started in 1991, has two objectives. One is to develop data collection guidelines for hydrocarbon leak and emission events. The second objective is to set up an initial database of release data.

3. ACCIDENT FREQUENCY DATABASES

Apart from the new fire and explosion database created as part of the study project, there is only one other, to our knowledge, accident database that is tied in to population data. The WOAD (an acronym for Worldwide Offshore Accident Database) database is being maintained by Veritec, a subsidiary of Det Norske Veritas. At this point in the study no use has as yet been made of this database and it is not known how useful, if at all, the database will be.

4. RELIABILITY DATABASES

Equipment reliability databases are of value to determine the anticipated failure rates of specific equipment or control devices. To our knowledge the only such database specifically prepared for the offshore oil industry is the Oreda (an acronym for Offshore Reliability Data) database.

The Oreda database program was initiated in 1983 by a number of oil companies operating in the North Sea. Results from the initial period of data gathering was published in the so-called Oreda handbook.[4] Subsequent phases of this project are, unfortunately, not available to non-participants.

The HARIS , acronym for Hazard and Reliability Information System, database contains reliability and maintainability information on a wide range of equipment and controls used in the nuclear, chemical and offshore oil industries.

Equipment and component reliability databases not specifically related to the offshore oil industry are now available from the American Institute of Chemical Engineers and from the U.S. Department of Defense.[5,6] These two databases may be particularly useful in determining the reliability of the safety control devices used on offshore facilities.

5. REFERENCES

1. Simiu, Emil: *"Reliability of Offshore Operations: Proceedings of an International Workshop,"* National Institute of Standards and Technology, Special Publication 833, April 1992.

2. Arnold, K.E. et al: *"Improving Safety of Production Operations in the U.S. OCS,"* OTC 6079, (1989).

3. Mineral Management Service: *"Accidents Associated with Oil and Gas Operations - Outer Continental Shelf 1965 - 1986,"* MMS OCS Report 88-0011, 1988.

4. OREDA: *"Offshore reliability data handbook,"* Oreda PennWell Books, (1984).

5. American Institute of Chemical Engineers: *"Guidelines for Process Equipment Reliability Data, with Data Tables,"* AIChE, 1989.

6. Department of Defense: *"NPRD-91 Non-electronic Part Reliability Data 1991,"* Reliability Analysis Center, 1991.

APPENDIX 5

METHODOLOGY USED TO CREATE NEW FIRE AND EXPLOSION DATABASE

1. New Frequency Database

A new fire and explosion frequency database was created by merging the following databases:

1. Fire and explosion database from 1981 through 1989,

2. Platform - Master database, and,

3. Platform Structures database.

Descriptions of these databases and their original formats are found in Appendix 4.

To enable merging the three databases they had to be converted into common formats. Figure 5.1 depicts the methodology and required intermediate steps that were required to accomplish this conversion. As noted, intermediate steps included conversion of the text based databases into the Excel spreadsheet database using the Q+E application program. From Excel these database were converted into the dBase IV database format and from there into the Paradox database format. Paradox was selected because of its relative ease in manipulating and extracting database information.

Figure 5.1. Database manipulations required to create new fire and explosion frequency database.